THE INFLUENCE FEEDING REGIMENS ON MEAT QUALITY TRAITS OF HEREFORD COWS IN URUGUAY

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Abstract – The objective this work was to study the effect of different nutritional strategies on meat quality and fatty acid composition in cull cows in Uruguay. The experiment combined different levels of forage allowance (FA) grazing a winter crop (oat and ryegrass) and the use of a supplement (rice bran; RB), for 130 days. Forty Hereford cull cows (480 kg of live weight; LW) were randomly assigned to four treatments (T) as a result of combining two levels of forage allowance (FA) and supplementation: T1=FA 4 % LW, T2=FA 2% LW, T3=FA 2% LW + RB 0.8% LW and T4=FA 2% LW + RB 1.6 % LW. The content of intramuscular fat (IMF), tenderness, colour and ultimate pH of *Longissimus dorsi* (LD) muscle aged for 7 and 14 days, were not affected by T (P>0.05). Linoleic acid (18:2 n-6) content was higher (P<0.01) in T receiving supplement (T3 and T4) and the opposite occurred for Linolenic acid (18:3 n-3) in T only based on pasture (T1 and T2). Similar trend was observed for long chain arachidonic (20:4 n-6), eicosapentaenoic – EPA (20:5 n-3), docosapentaenoic – DPA (22:5 n-3) y docosahexaenoic – DHA (22:6 n-3) fatty acids, where the concentrations were significantly higher for T2 in comparison to T1, T3 and T4 (P<0.05). The conjugated Linoleic acid (CLA) content, saturated fatty acids (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids did not differ between T. The omega6/omega3 (n6/n3) ratio was different between T (P<0.01) and ranged between 1.88 and 3.72, being T1 = T2 < T3 = T4. This study demonstrated that the different nutritional strategies did not influence the quality characteristics of the meat´s quality traits studied. However, the diets had a marked effect on fatty acid composition.

KEYWORDS: feeding systems, cows, meat quality, fatty acid composition

I. INTRODUCTION

One of the challenges that the Uruguayan meat industry faces nowadays, is to meet the increasing demand of high quality meat required by the international market. To achieve this goal is required to development and adapt option technologies that enhance productivity and farm profit as well as promoting product quality and human health. National and international research have established that different feeding strategies in steers (pasture versus concentrates feeding) influence meat quality traits and fatty acid composition. In Uruguay, during the last 10 years, cow slaughtering holds a very important position in the overall national slaughter, being on average 45% (1). However, national research in fattening cull cows is scarce and more studies need to be established to further improve product quality in this important Uruguayan exporting category. Therefore, the objective of this study was to evaluate the effect of different levels of forage allowances combined with the use of rice bran supplementation during winter on meat quality traits and fatty acid composition in Hereford cull cows.

II. MATERIALS AND METHODS

This experiment was carried out at "Glencoe" Experimental Unit – INIA Tacuarembó, situated in the Basaltic region of Uruguay. Forty Hereford cull cows, with an average initial live weight (LW) of 480.2 ± 10.1 kg, grazing on annual winter crop (oat + ryegrass) were randomly assigned to four treatments (T) for 130 days: T1=forage allowance (FA) of 4% LW, T2=FA 2% LW, T3=FA 2% LW plus rice bran (RB) supplementation (S) 0.8% LW and T4=FA 2% LW plus S 1.6% LW. The animals were divided into two replicates of four plots each. The animals of the

supplemented treatments had a S intake adaptation period (10 days) prior to the beginning of the experiment. The supplement was distributed once a day in the early hours of the morning. During the whole experiment animals had free access to fresh water and mineral blocks. The forage used was Byzantine oat (*cv*. INIA Halley) and spontaneous ryegrass plants generated from previous seedings. Animal measurements were taken weekly for LW gain and every 42 days for fasted LW gain. For T3 and T4, the feed intake was adjusted every 14 days, according to the average LW of the animals of each plot. The cull cows were slaughtered at a commercial packing plant with an average LW of 593.4 kg. After slaughter and 48 hours *post mortem,* carcasses were cut apart between 10-11th ribs and separated into primal cuts. Measurements on meat quality and fatty acid composition were taken on the *Longissimus dorsi* (LD) muscle. At 48 hours *post mortem*, ultimate pH was recorded using pHmeter (Hanna HI 9125) with a gel device. Meat marbling was determined according to the Classification System of the USDA Quality Grade. Two steaks 2.54 cm thick, were vacuum packaged individually and aged for 7 and 21 days at 2-4°C for meat colour measurements (parameters L*, a* and b* with a Minolta CR 400 colorimeter) and toughness determination (Warner Bratzler model D2000-WB). The LD steaks were placed inside polyethylene bags and cooked in a cater bath until an internal temperature of 70°C was achieved. Six 1.27 cm diameter cores were removed from each steak, parallel to the muscle fibers orientation. A single peak shear force measurement shear force measurement was obtained for each core using WB and an average value was calculated for each steak. Total lipid content was measured by solvent extraction based on the Folch *et al*. (1957) method and fatty acids were quantified by gas chromatography. Fatty acids are expressed as a percentage of the sum of all fatty acids measured. Results were analyzed by variance test using the GLM procedure of SAS (3). LS means and differences among treatments were estimated (P<0.05 or P<0.01).

III. RESULTS AND DISCUSSION

The effect of feeding treatments on meat quality traits are shown in Table 1. There were no differences in ultimate pH values between treatments, all of them being below 5.8. Similar findings are suggested by (4), where WBSF values with 7 or 21 days of aging were similar among treatments (P>0.05). However, a difference can be ascertained between different times of aging. With 7 days of aging, in T1, T2 and T3, 60% of de samples displayed values above 4.5 kgF and in T4 this value was found in 70% of the samples. On the other hand, with 21 of days of aging, 100% of the T1 and T2 samples displayed values below 4.5 kgF, while T3 and T4 registered 90% of the samples with this value. Muscle colour is an important parameter used by consumers for purchasing decisions. With 7 and 21 days of aging, treatments had similar values for L*, a* and b* (P>0.05). In similar studies with steers (4), found comparable tendencies. In another trial performed (5) in Uruguay, under more intensive steer finishing regimes, tenderness values were generally higher and a* and b* parameters were affected significantly by the production system (5) (6). The different feeding strategies were not significantly different (P>0.05) for intramuscular fat content, although a trend was observed towards a lower content in T2.

The fatty acid composition of the intramuscular fat (IMF) of *Longissimus dorsi* for all treatments is presented in Table 2. Intramuscular fat content was not affected (P>0.05) by treatments. However, differences were observed in the proportion in some fatty acids. The concentrations of Linoleic acid (18:2 n-6), was greater when concentrates were supplied. However, as expected, the concentration of PUFA n-3, increased as concentration pasture increased in the overall diet (P<0.01). The UK Department of Health (4) recommends that PUFA/SFA and n6/n3 ratios should be over 0.45 and below 4.0, respectively. In this trial, the feeding system did not affected the PUFA/SFA (P>0.05) ratio, being lower than the recommended value. Regarding the n6/n3 ratio, all treatments were lower than the recommended level, following the pattern of T4 = T3 > T2 = T1 (P<0.01). Similar results were reported by (5), (6), (7) and (8).

Table 1. Mean values for meat quality traits under the influence of different nutritional regimes.

Variable	T1	T2	T3	T4	P
pH 48 hs	5.65	5.63	5.63	5.61	ns
WB kg SF (7d)	4.66	4.77	5.61	4.86	ns
WB kg SF (21d)	3.54	3.47	3.65	3.63	ns
L* muscle (7 d)	34.4	33.9	34.8	34.7	ns
a* muscle (7 d)	17.5	17.3	17.3	17.9	ns
b* muscle (7 d)	9.4	9.2	9.6	9.5	ns
L* muscle (21 d)	37.0	35.9	36.3	36.7	ns
a* muscle (21 d)	16.7	17.2	16.4	17.4	ns
b* muscle (21 d)	9.9	10.1	9.9	10.1	ns

Note: ns= not significant.

Table 2. Fatty acid profile (%) composition of the *Longisimus dorsi* muscle under the influence of different nutritional regimes.

Fatty acid (%)	T1	T2	T3	T4	P
Intramuscular fat	4.70	3.52	4.61	4.13	ns
14:0 *myristic*	2.56a	2.13b	2.28ab	2.15 b	*
16:0 *palmitic*	28.59	27.53	27.74	27.36	ns
18:0 *stearic*	15.73	16.22	15.69	17.10	ns
20:0 *arachidic*	0.05b	0.09a	0.03b	0.05b	*
14:1 *myristoleic*	0.40	0.35	0.40	0.30	ns
16:1 *palmitoleic*	3.96	3.78	4.04	3.44	ns
18:1 *oleic*	44.89	44.96	45.61	44.84	ns
18:2 *n-6 linoleic*	1.72c	2.03bc	2.34ab	2.7a	**
18:3 *n-6 linolenic*	0.04	0.04	0.04	0.05	ns
18:3 *n-3 linolenic*	0.56ab	0.72a	0.42b	0.41b	**
20:2 *n-6 eicosadienoic*	0.02	0.03	0.02	0.02	ns
20:3 *n-3 ETE*	0.08	0.14	0.13	0.14	ns
20:3 *n-6 DGLA*	0.04	0.05	0.03	0.05	ns
20:4 *n-6 arachidonic*	0.41b	0.76a	0.47b	0.56ab	*
20:5 *n-3 EPA*	0.19ab	0.27a	0.12b	0.13b	**
22:5 *n-3 DPA*	0.23ab	0.34a	0.15b	0.19b	**
22:6 *n-3 DHA*	0.08ab	0.09a	0.06b	0.05b	*
CLA	0.46	0.50	0.44	0.37	ns
SFA	46.93	45.95	45.75	46.47	ns
MUFA	49.25	49.09	50.04	48.59	ns
PUFA	3.37	4.47	3.77	4.34	ns
n6	2.23b	2.90ab	2.90ab	3.42a	**
n3	1.14ab	1.57a	0.87b	0.92b	**
PUFA/SFA	0.08	0.10	0.08	0.09	ns
n6/n3	2.04b	1.88b	3.50a	3.72a	**

Note: a, b = means with different letters among columns are significant different (*, P<0.05) and (**, P<0.01). ns= not significant. ETE: eicosatrienoic acid; DGLA: dihomo-gamma-linolenic acid; EPA: eicosapentaenoic acid; DPA: docosapentaenoic acid; DHA: docosahexanoic acid; CLA: conjugated linoleic acid; SFA: satured fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids.

IV. CONCLUSION

Under the conditions imposed in the present study, there were no differences due to the feeding regimes evaluated on meat quality attributes in cull cows. Nonetheless, different feeding system had a significant impact on fatty acid composition, especially in the ratio of n6/n3 ratio, which was higher in supplemented treatments. This study shows the appropriate effect of grass fed cull cows and low levels of supplementation to promote a healthy human diet.

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